Applications of silicon-based photonic crystals

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Silicon is the dominant material in semiconductor industry to date. Novel nanostructuring technologies, such as ICP-plasma etching, photo-electrochemical etching as well as colloidal self-assembly of monodisperse silica spheres, may lead to novel application of silicon in photonics.

Three different areas of applications will be discussed: integrated optical devices, sensors and photovoltaic devices. In the area of integrated optics, the properties SOI ridge waveguides and photonic crystal waveguides will be discussed and the possibility of tuning the optical properties. Concerning sensing, novel design for the gas interaction compartment based on macroporous silicon photonic crystals are presented. Macroporous silicon can be prepared uniformly on 6-inch silicon wafers and the holes can penetrate the whole silicon wafer. This enables gas flow through the holes and optical detection perpendicular to this direction in the plane of the periodicity. Finally, possible applications in the area of third generation solar cells are presented such as spectrum splitting and fluorescence collection. Intriguingly, this is an area has been suggested initially for photonic crystals [1] but has never been followed up.

[1] E. Yablonovitch, *Phys. Rev. Lett*. 58, 2059 (1987).